



University of Salahadin
College of Engineering
Electrical Engineering Dept.



Distributed Generation
Chapter Two
Diesel Generator

By:
Sarkar Jawhar
MSc in Electrical Engineering

Contents of This Lecture

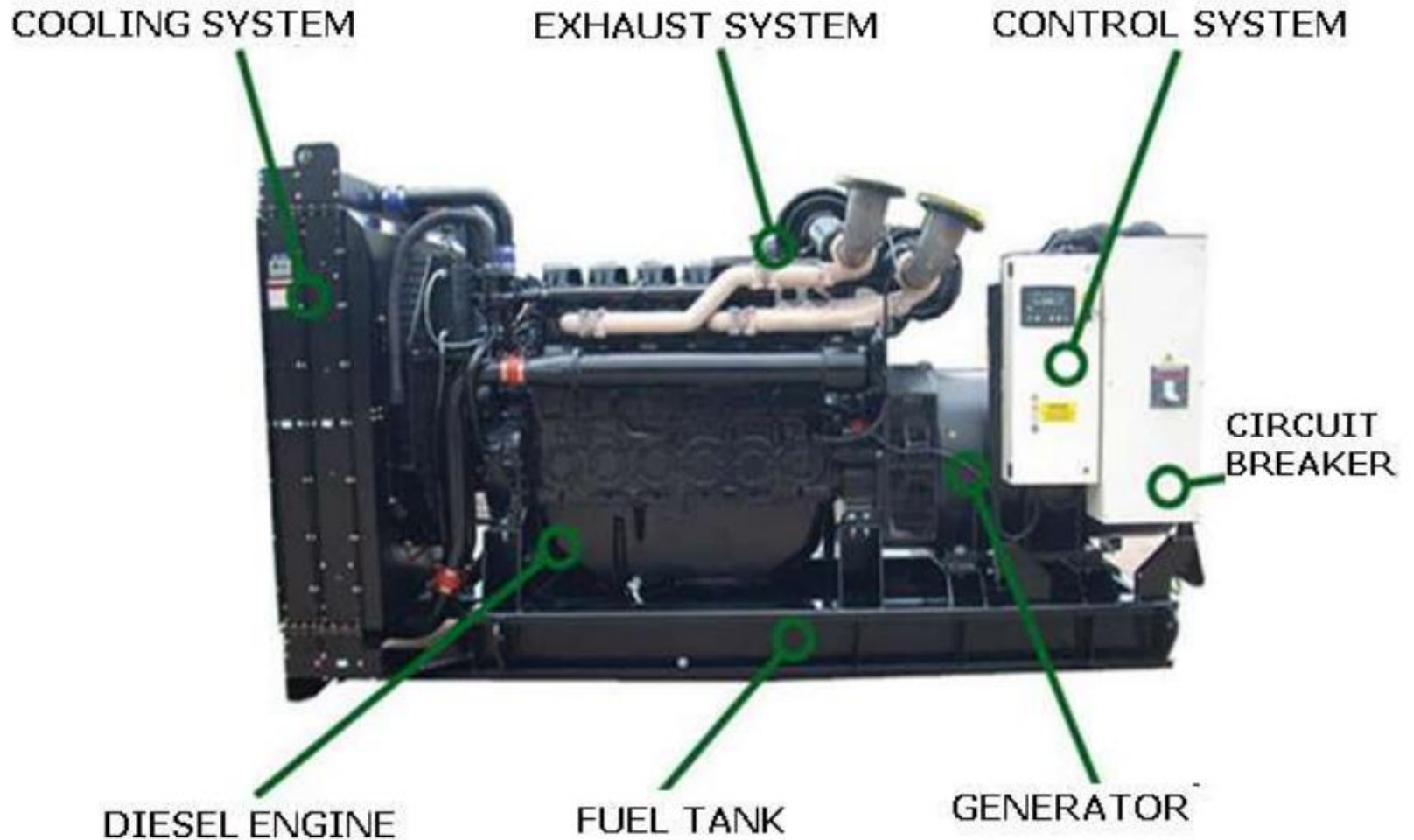
- Diesel Generator Components and Main Systems
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Definition

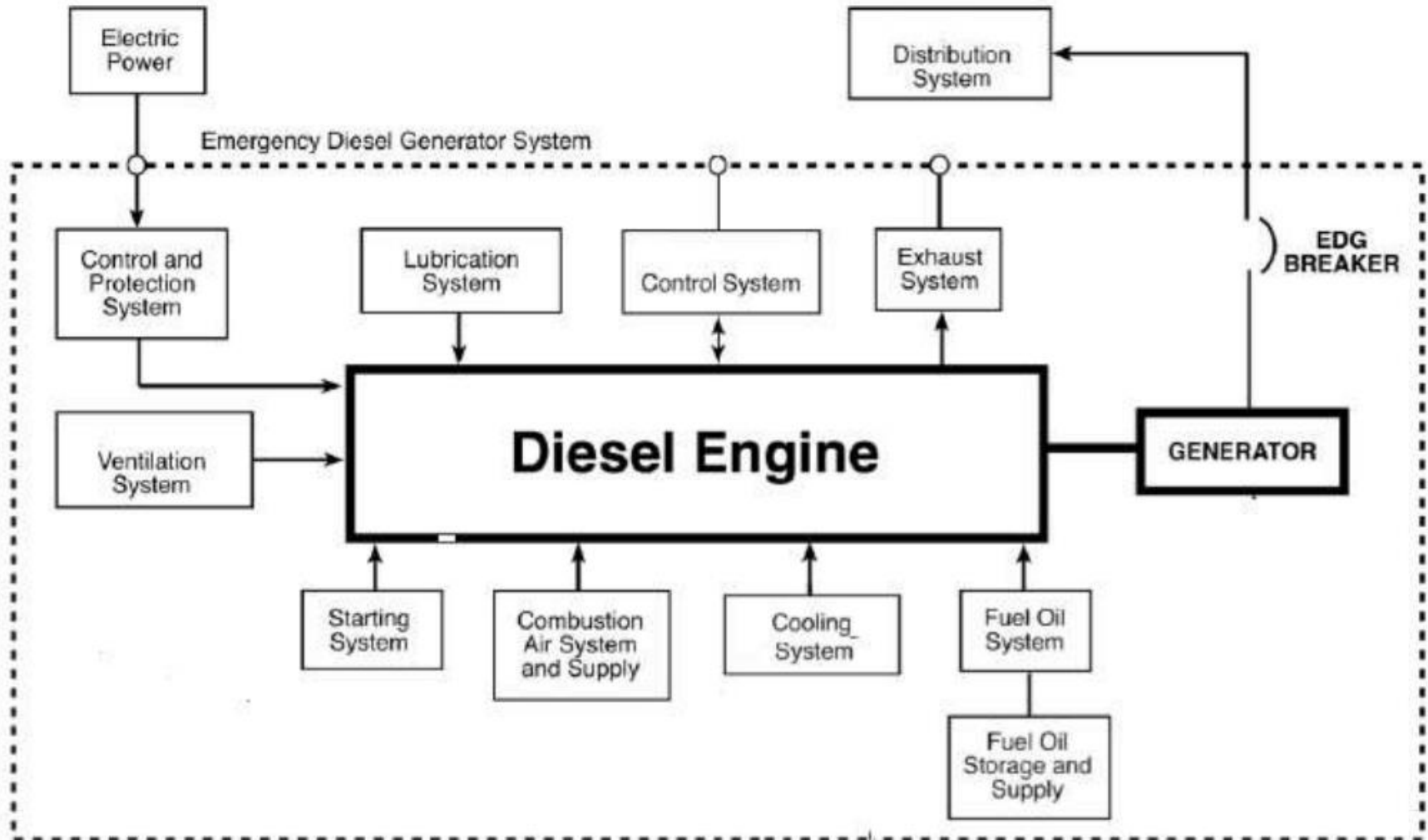
A **Diesel Generator** is the combination of a **diesel engine** with an **electric generator** (often called as **alternator**) to generate Electrical energy from fuel.



Diesel Generator Components

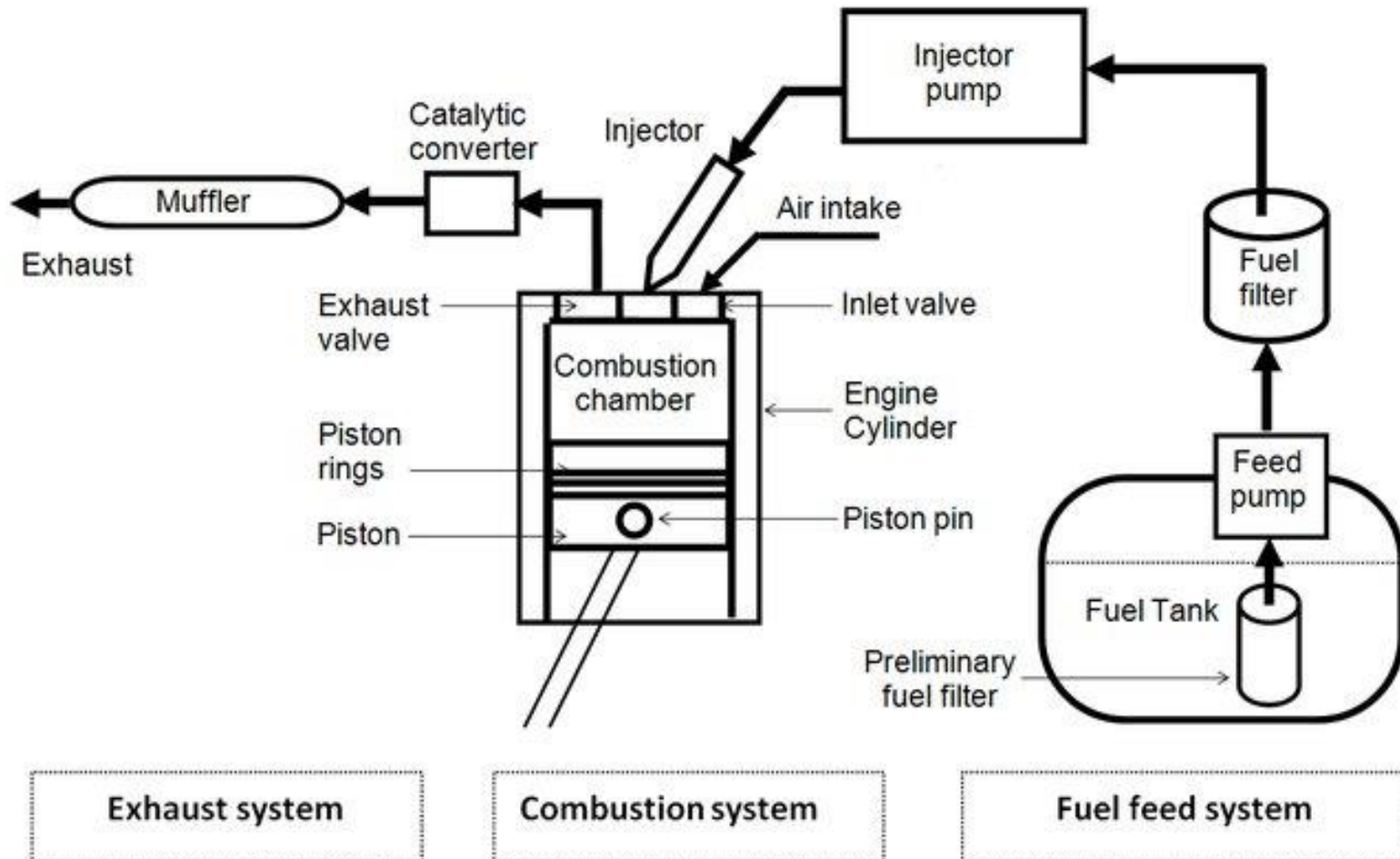


Diesel Generator Main Systems

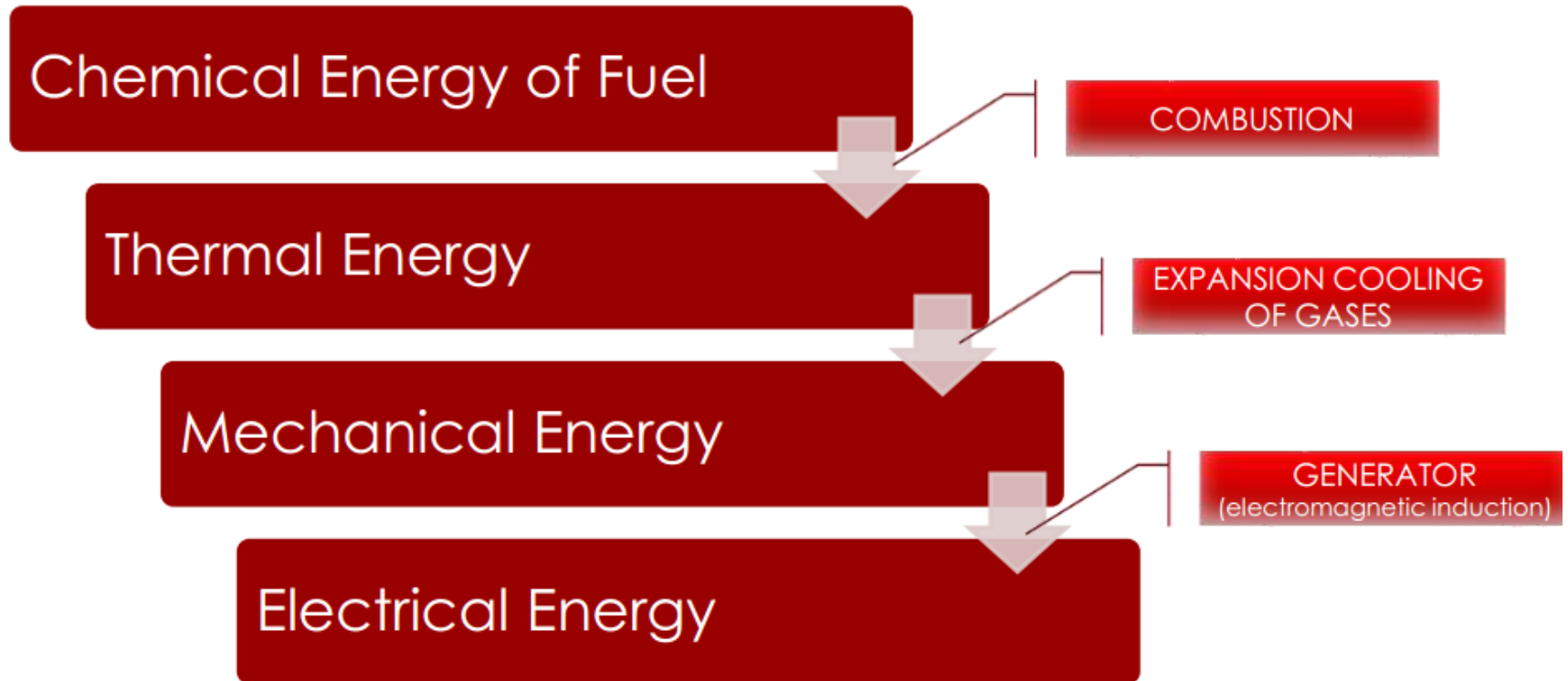


Working Principle

Schematic diagram of a typical diesel engine generator systems.

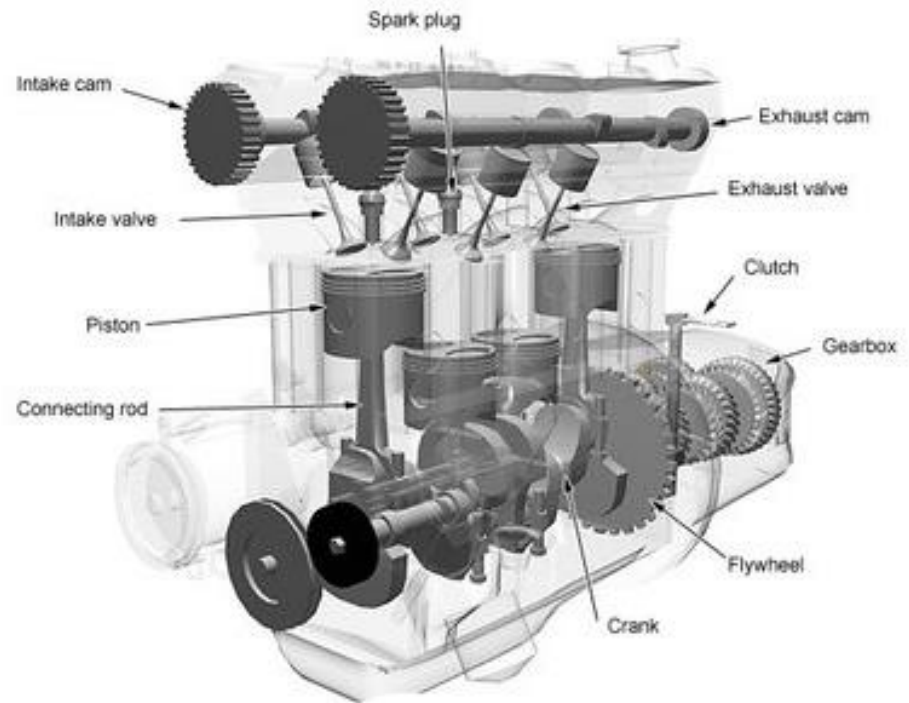


Working Principle



Diesel Engine

A **diesel engine** much like a large vehicle engine. It works with diesel fuel. The bigger the source of mechanical energy, the more electrical power can come out.



Parts of Diesel Engine

1. Cylinder block
2. Piston
3. Piston rings
4. Connecting rod
5. Piston pin
6. Crankshaft
7. Flywheel
8. Cylinder head
9. Intake and Exhaust valves
10. Camshaft
11. Timing gears
12. Liner

Parts of Diesel Engine

Cylinder Block

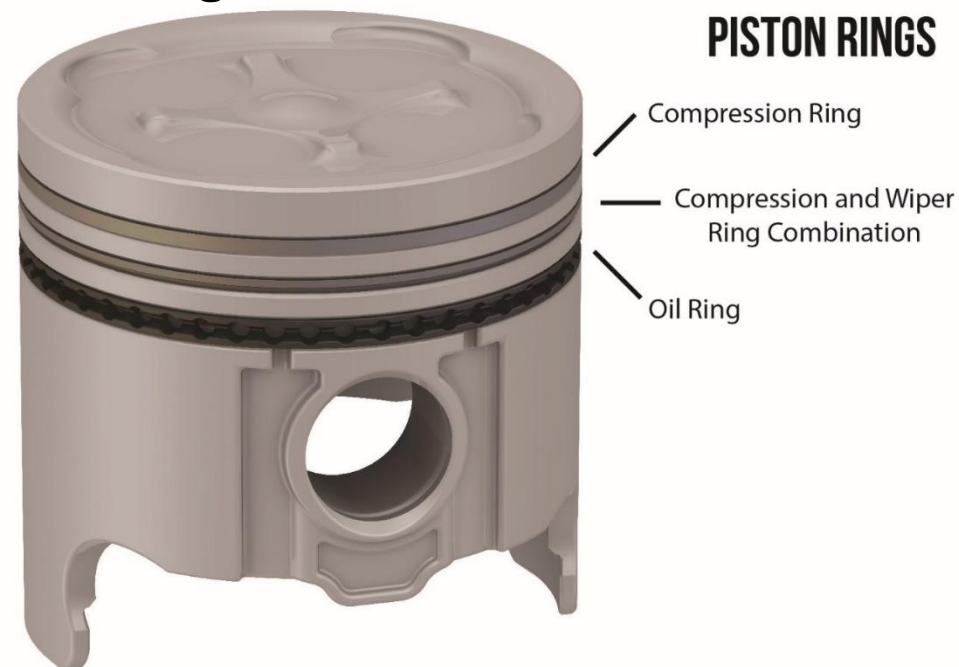
Basic frame of the engine. It contains the cylinder.



Parts of Diesel Engine

Piston and Piston Ring

A sliding plug that harnesses the force of the burning gases in the cylinder. The rings seal the compression gases above the piston keep the oil below the piston rings.



Parts of Diesel Engine

Connecting Rod

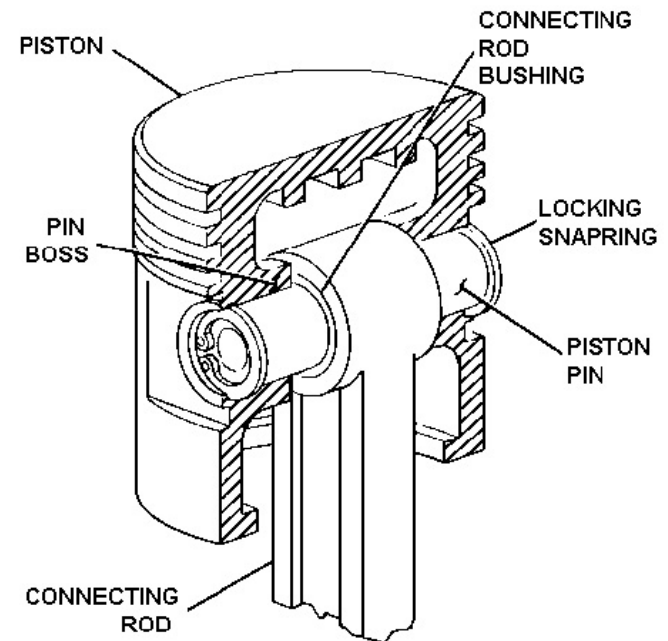
Connects the piston to the crankshaft.



Parts of Diesel Engine

Piston Pins

Also known as the wrist pin, it connects the piston to the small end of the connecting rod. It transfers the force and allows the rod to swing back and forth.



Parts of Diesel Engine

Crankshaft

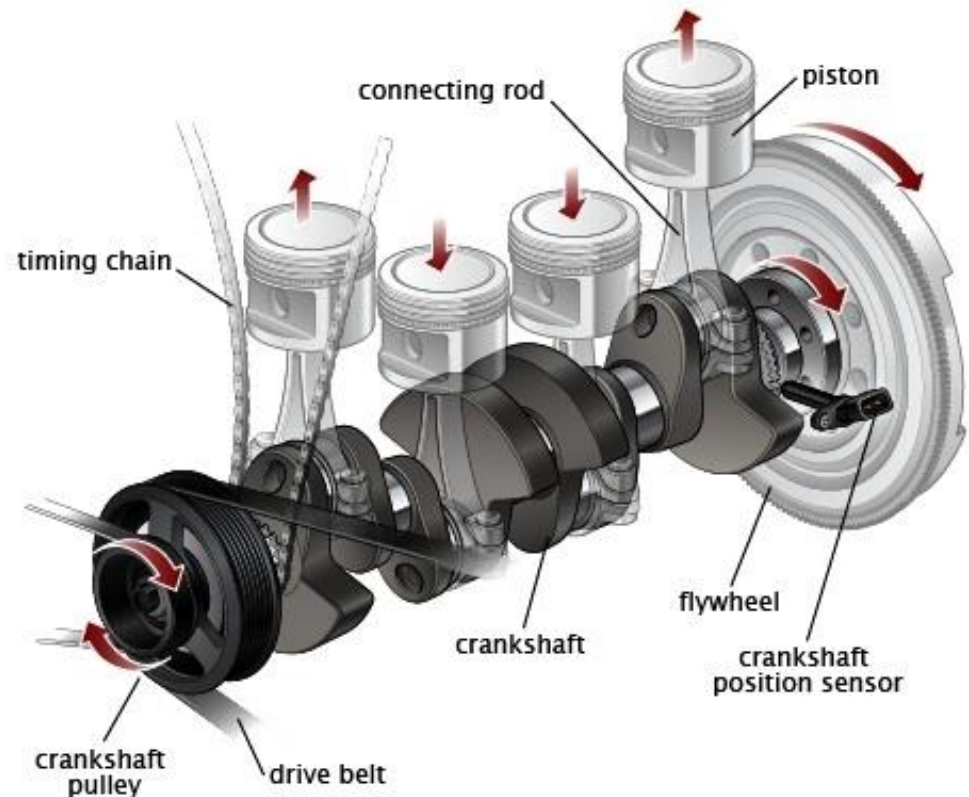
Along the piston pin and connecting rod it converts the up and down motion of the engine to rotary motion.



Parts of Diesel Engine

Flywheel

Carries the inertia when there is no power stroke.



Parts of Diesel Engine

Cylinder Head

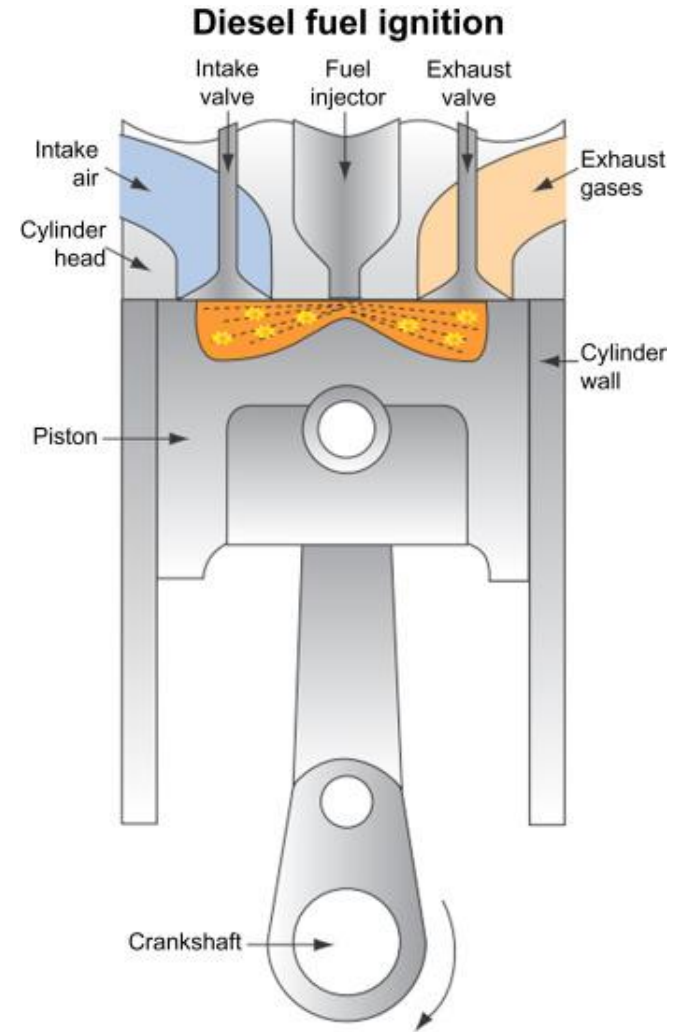
Forms the top of the combustion chamber. Contains the valves, the passageways for the fuel mixture to move in and out of the engine.



Parts of Diesel Engine

Intake and Exhaust Valves

Doorway that lets the air in and gases out of the engine. Intake valves about 25-30% bigger than exhaust valves.



Parts of Diesel Engine

Camshaft

Through the use of an eccentric the cam lobes push the valves open. The valve springs close them.



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Parts of Diesel Engine

Timing Gears

These gears drive the camshaft from the crankshaft.



Parts of Diesel Engine

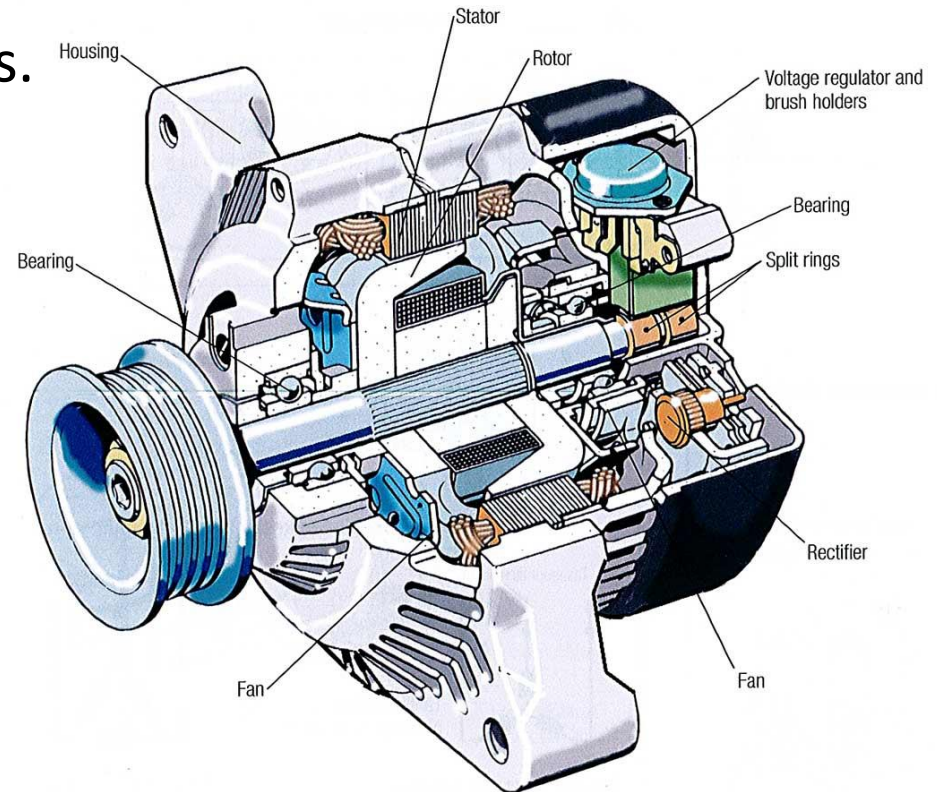
Liner

Forms the wall of the combustion chamber. Guides the movement of piston.



Alternator

This is the part that turns the mechanical energy (the rotation of the shaft) into electrical power through induction. It could be single phase or three phases.



Alternator

Rotor

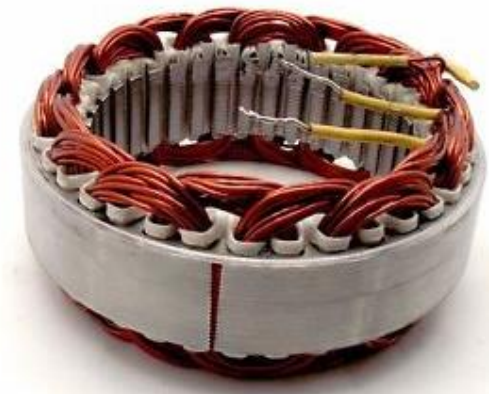
Several large powerful magnets is places in a cluster around a rotating shaft. This is called the 'rotor' or 'armature'. The magnets might be permanent magnets or electromagnets, which the engine causes to turn.



Alternator

Stator

It is essentially a series of tightly bundled coils of wire, all packed closely around the rotor. When a diesel engine turns the central shaft, the rotor constantly moves the north and south poles of its magnetic field across the bundles of wire that surround them. This produces an AC electrical current through the wires.



Voltage Regulator

- This is an important component, without it, the voltage and amperage of the AC current provided would vary according to the speed of the engine.
- Large AC generators commonly use a combination Exciter-Voltage Regulation system to maintain generator field current under varying electrical loads.
- The basic voltage regulation system is designed to automatically regulate generator output terminal voltage within close tolerances of a specified value.

Voltage Regulator

- The voltage regulation system is a 'closed loop' feedback system in which generator output voltage is automatically compared to a reference voltage. The error signal is used to change generator excitation.

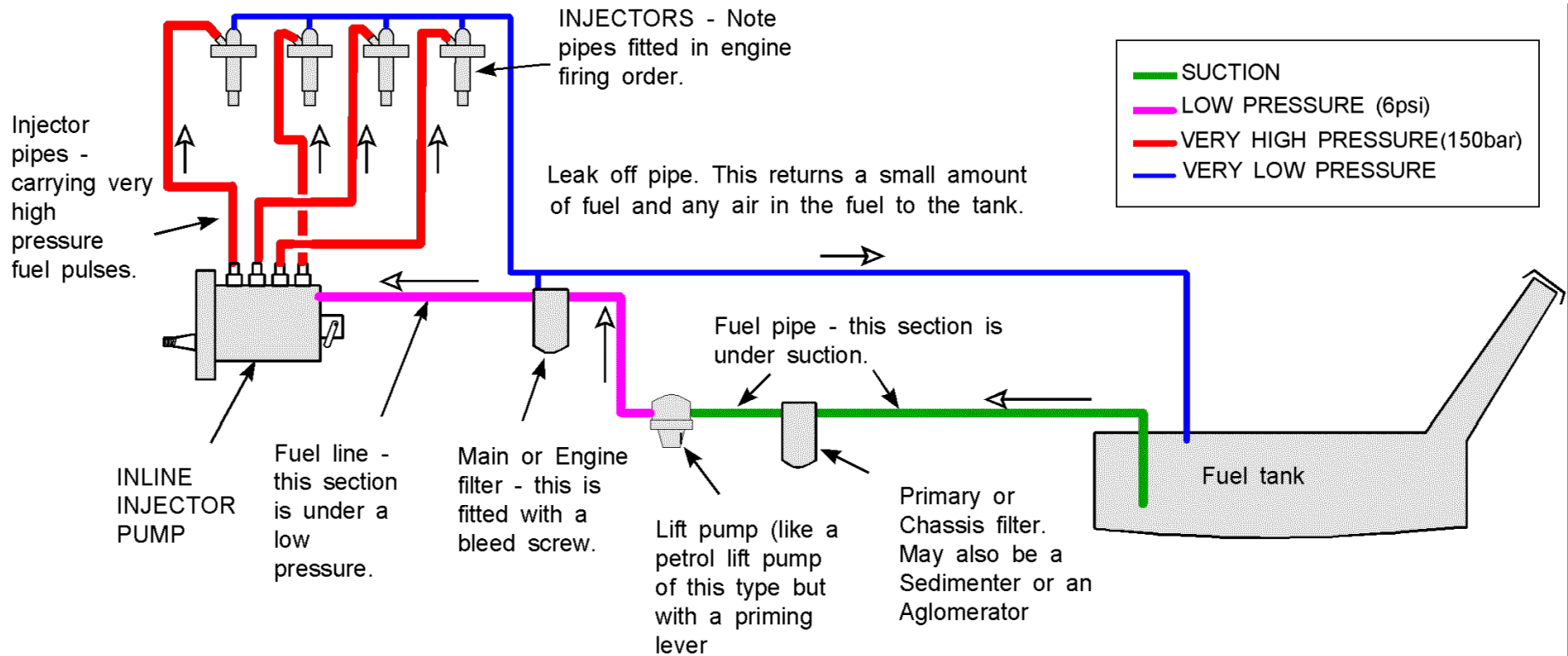


Fuel System

- This is typically the diesel fuel supply for the engine.
- A tank holding enough fuel for at least 6-8 hours of operation.
- This tank may be inside the generator housing for small or it may be a separate external structure for larger units.
- The pipe-work to get the fuel to the engine, a fuel pump similar to the one in most vehicles, a fuel filter, and a ventilation pipe or valve for the fuel tank, preventing overpressure or vacuum inside.

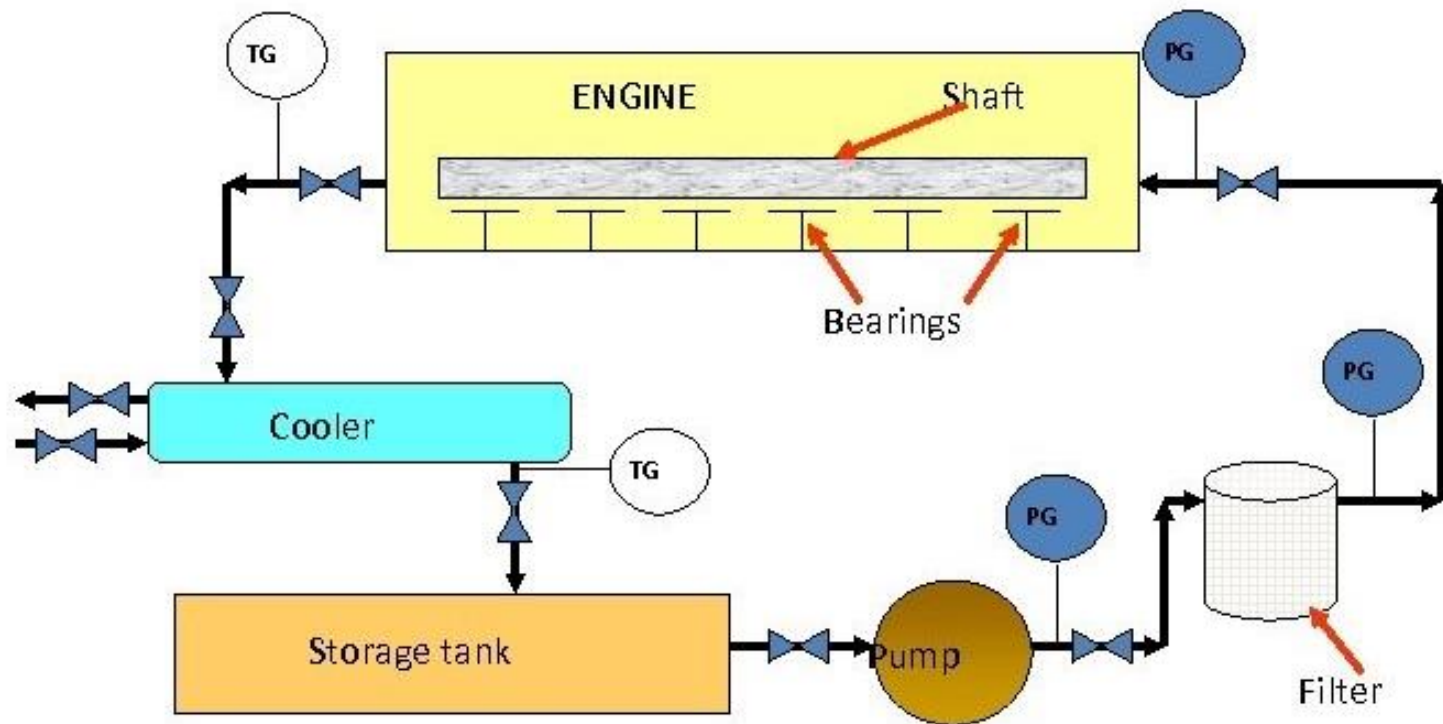
Fuel System

- There will also be an overflow connection ensuring that if the tank is overfilled.



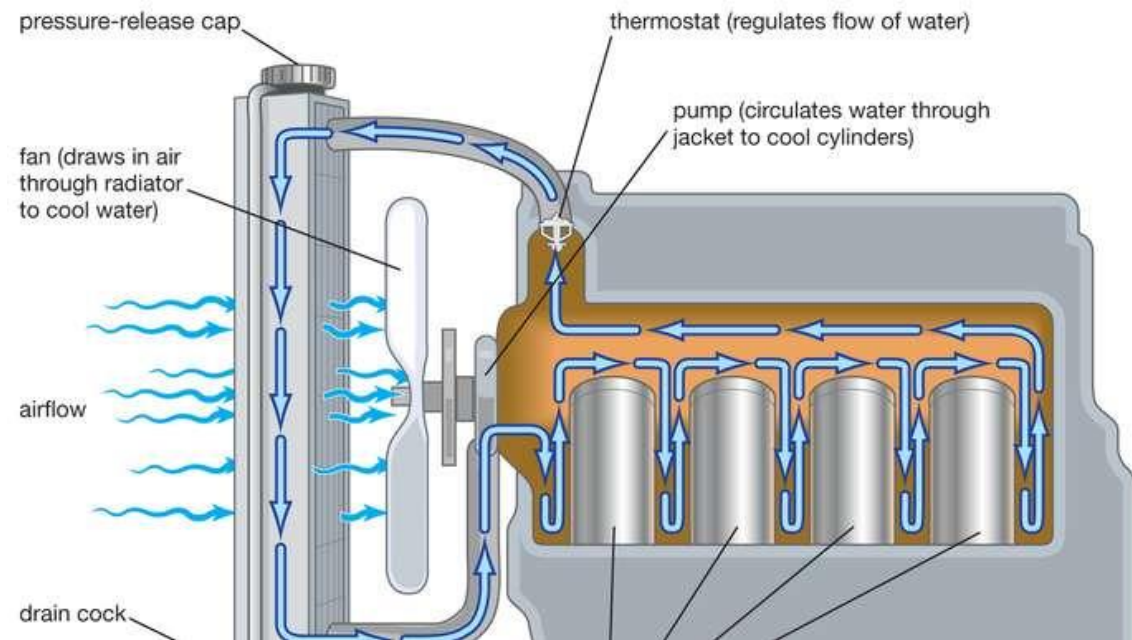
Lubrication System

- Any engine requires lubrication, and this is handled by an oil pump and reservoir attached to the engine itself.
 - TG- Temperature gauge
 - PG- Pressure gauge



Cooling System

- Just like in a vehicle, the engine produces a great deal of heat in addition to mechanical energy.
- This heat is soaked up by a coolant fluid (water) which then runs through a heat exchanger, dumping its heat typically into the air.



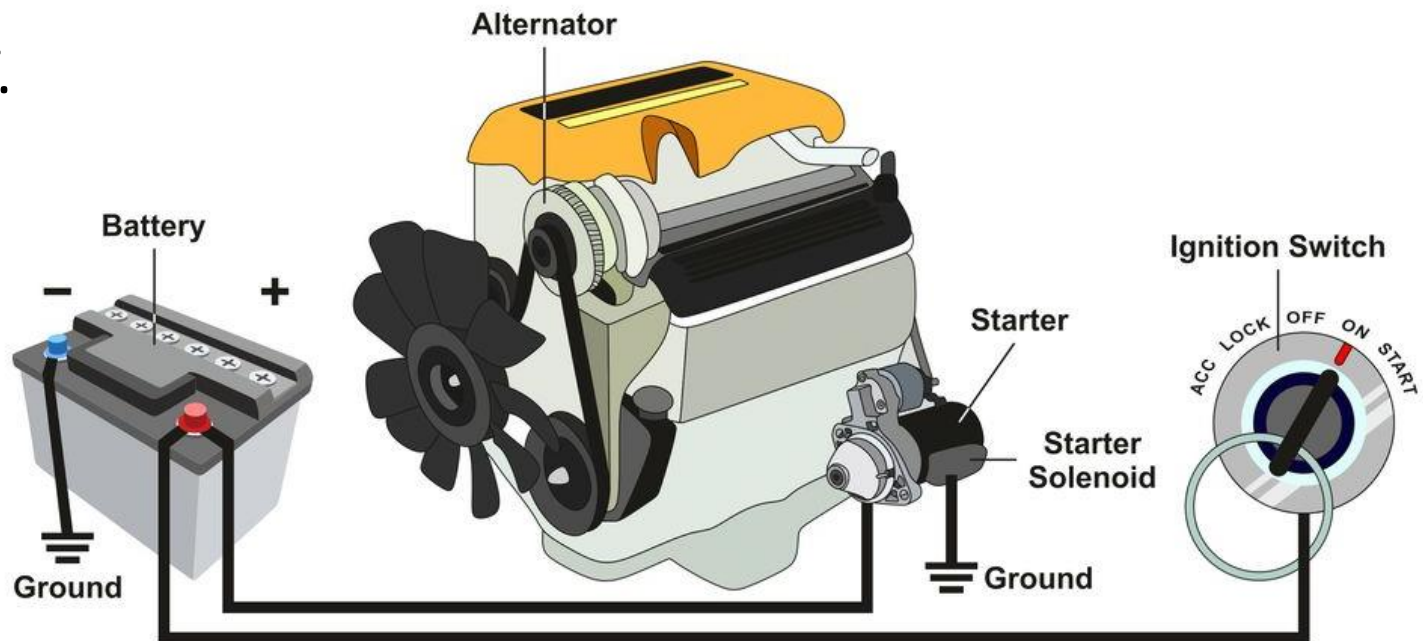
Exhaust System

- All internal combustion engines produce exhaust gases.
- These are toxic and must be directed away from the engine itself and any nearby people.
- Exhaust gases are typically channeled through pipes and vented into the outside air.
- There are typically health and safety regulations about exhaust systems.



Starter & Battery System

- The diesel engine relies on a small electrical motor to start running.
- This electrical starter motor is powered by a battery, which is charged by either a separate charger or the generator output itself.



Control Panel

Control panel is where the generator is operated which includes:

1. Start/shutdown controls
2. Phase selector switch
3. Frequency switch
4. Engine mode switch
5. Engine fuel
6. Engine oil
7. Engine speed
8. Coolant temperature
9. Battery charge
10. Generator output voltage
11. Generator output current
12. Generator Output in kVA
13. AC power frequency



The frame / Housing

- The diesel generator will either be contained in a weatherproof housing, an open structural frame, or a transportable unit.
- All of these functions keep the components together and solidly attached. It also ensures that all electrical components are safely grounded.



The Canopy

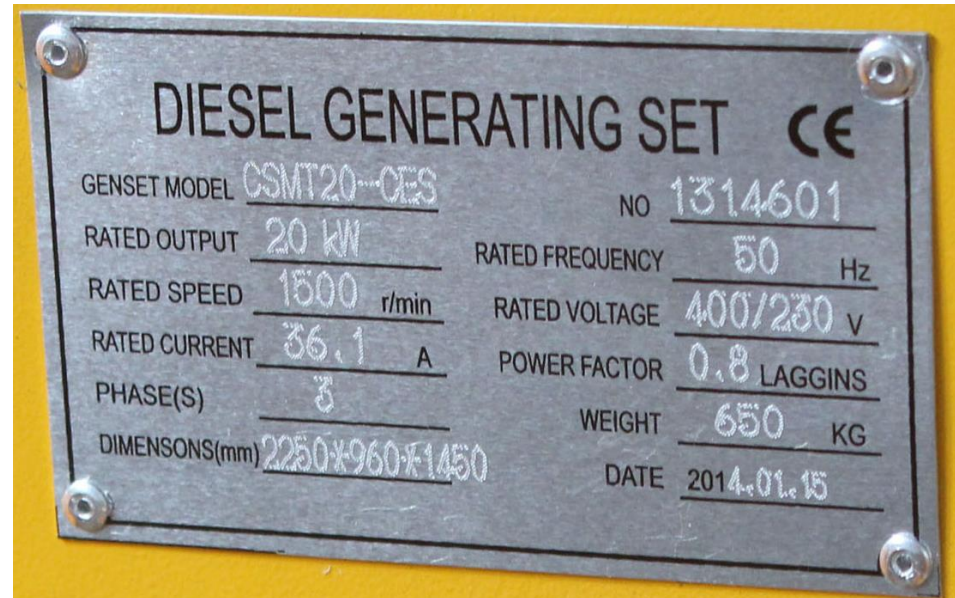
- A diesel generator can also be covered in an acoustically treated canopy which dramatically reduces the dB level.
- A generator with an acoustic canopy covering the other elements is often referred to as a Silent Generator.



Name plate

Typical name plate data for a diesel generator includes:

1. Manufacturer, Serial number and type number.
2. Speed (rpm).
3. Number of poles.
4. Output frequency.
5. Number of phases.
6. Maximum supply voltage;
7. Capacity rating in KVA and kW.
8. Armature and field current per phase.
9. Maximum temperature rise.



Size of Diesel Generator

Full Load KW = No X Watt X Diversity Factor / 1000

Full Load KVA = KW / P.F

Full Load current = Full Load KVA*1000 / Volt

Starting KVA = Factor X Load KW / Starting P.F

Starting Current= Percentage Factor of Full Load Current

- The **Diversity Factor** is the ratio of the sum of the maximum load of part of a system to the maximum load of the whole system.

Size of Diesel Generator

Type of Load	Equipment	Starting Current
Linear	Transformers, motors and capacitors ...	100% of Full Load Current
Non-Linear	Rectifiers, variable-speed drives and electronic devices ...	160% of Full Load Current

Type of Starter	Starting Current
Variable Frequency Drive (VFD)	1.5 X Full Load Current
Soft Starter	2 X Full Load Current
Auto Transformer	3 X Full Load Current
Star-Delta	4 X Full Load Current
Direct On Line (DOL)	6 X Full Load Current

Example

Calculate Size of Diesel Generator having following Electrical Load. Consider 80% of its capacity for continuous usage and future expansion ratio is 10%.

#	Description	Qty	Power	Diversity Factor	Starting P.F	Running P.F
1	CFL Bulb, 1Ph, 220V	4	80 W	0.8	0.8	0.8
2	Halogen Light, 1Ph, 220V	2	500 W	0.8	0.8	0.8
3	Air Condition, 1Ph, 220V	2	3000 W	1	0.8	0.8
4	Motor with Y-D Starter, 1Ph, 220V	1	10 KW	0.8	0.7	0.8
5	Motor with Soft Starter, 3Ph, 400V	1	130 KW	0.8	0.7	0.8

Next Lecture

- Microturbine

Questions and Thank you

*Thank
you*